REGIONAL ECOLOGY OF THE ST. ELIAS MOUNTAIN PARKS

A Synthesis with Management Implications

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ABSTRACT

The St. Elias region of North America occupies portions of British Columbia, Alaska, and the Yukon Territory and comprises a network of public lands and protected areas managed by a variety of agencies. This thesis characterizes and analyzes the broad-scale, or regional, ecology of these lands and provides an assessment of the implications this has for ecosystem-based management - particularly as it relates to intergovernmental cooperation. A multi-stage, map-based, multidisciplinary process is used to synthesize information on the region's physical, biological, and institutional environments. The fields of conservation biology and landscape ecology provide theoretical foundations for analysis.

The ecological synthesis and analysis illustrates numerous ecosystem components that are shared throughout the entire St. Elias region as well as physical and biological features and processes that serve as linkages between the region's parks and protected areas. Yet the synthesis and analysis also indicate that there are equally as many differences between the parks and protected areas, and that these areas are just as closely linked with surrounding unprotected areas. In combination, these results indicate that the greater St. Elias region actually represents the point at which several different regional-scale ecosystems converge, rather than a single, coherent ecological unit.

These results suggest that an ecological foundation for improved cooperation between management agencies does exist, but not in the form of an integrated, region-wide initiative as originally anticipated. Instead, the regional ecology of the St. Elias Mountain Parks and surroundings seems to advocate a more process-oriented approach to management wherein the exact boundaries of management are of secondary importance to the development of a coordinated set of principles, goals, and objectives to guide planning and management. Nevertheless, defining spatially-oriented frameworks for integrated intergovernmental cooperation is seen as a key component of facilitating ecosystem-based management and five such areas are identified and recommended. The use of adaptive management and cumulative effects assessment are seen as valuable tools for use in ensuring the maintenance of ecological integrity and wilderness character of these areas and the region as a whole.

This thesis represents the first study to systematically examine the protected areas of the St. Elias region as a collected unit, thereby transcending political boundaries. The attached CD contains a digital version of the thesis, including the complete set of full-colour maps. Adobe's "Acrobat Reader" is required to open these files and is readily available for downloading at no charge from http://www.adobe.com.

EXECUTIVE SUMMARY

INTRODUCTION

The St. Elias region of North America (Figure 1) is comprised of a network of public lands and protected areas managed by a variety of federal, state, provincial, and territorial agencies. Four areas constitute its protected core: Wrangell-St. Elias National Park and Preserve and Glacier Bay National Park and Preserve in Alaska, Kluane National Park and Reserve in the Yukon Territory, and the Tatshenshini-Alsek Wilderness Provincial Park in British Columbia. These four parks span a total combined area of 98,300 km^2. Two congressionally legislated Wilderness areas in Alaska's Tongass National Forest - Russell Fiord and Endicott River - add another 1,811 km^2 to this protected area. Finally, Tetlin National Wildlife Refuge in Alaska adds an additional 3,739 km^2 to the total area, rounding out what is the second largest contiguous protected area in the world. Specially managed areas - the Kluane Wildlife Sanctuary in Yukon, and the Chugach and Tongass National Forests in Alaska - add further to this transborder protected area (Table 1).

The primary goal of this thesis was to characterize the regional ecology of St. Elias region and, in turn, provide some assessment of the implications this has for its management - particularly as it relates to cooperation between parks and protected areas and adjacent unprotected lands. Several objectives were identified to assist in meeting this goal:

i. Compile an extensive database on the biophysical nature and institutional setting of the St. Elias Region and build this database into an integrated geographical information system (GIS);
ii. Identify and describe existing cooperation and coordination between protected areas and surrounding land agencies in the St. Elias Region as well as shared management objectives and common management issues;
iii. Generate a regional biophysical synthesis of the St. Elias through integrative mapping and analysis for the purpose of identifying similarities and differences within the region as well as shared ecological features and processes and key linkages between its protected areas and adjacent lands; and,
iv. Analyze the synthesis with a view to assessing the biophysical basis for coordinating intergovernmental cooperation within a framework for ecosystem management - particularly as these activities relate to the conservation of biodiversity and maintenance of ecological integrity.

A methodological process loosely based on the ABC resource survey method (Nelson *et al.*, 1988)[1] was used to meet these objectives and the fields of conservation biology and landscape ecology provided theoretical foundations for analysis (Figure 2). The following subsections summarize how these four goals were met and the conclusions which were made.

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[1] Nelson, J.G., P. Grigoriew, P.G.R. Smith, and J.B. Theberge. 1988. The ABC Resource Survey Method, The ESA Concept and Comprehensive Land Use Planning and Management. In; M. Moss (ed.), *Landscape Ecology and Management*. pp. 143-175. Polyscience Publications Inc, Montreal, PQ.

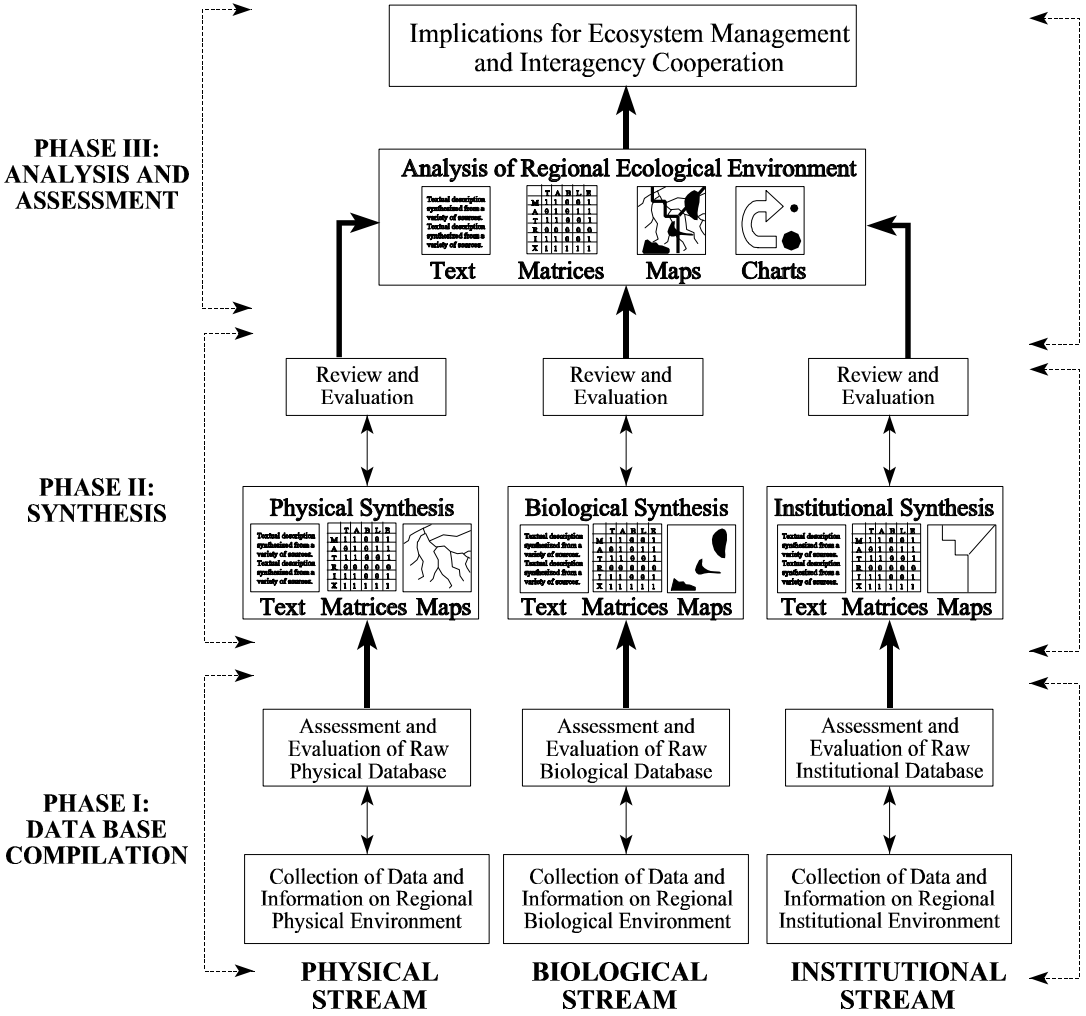
Figure 1: The Greater St. Elias Region of North America

Table 1: Parks and Protected Areas of the St. Elias Region

Park/Protected Area	**Management Agency**	**km²***	**IUCN Class**	**Year Est. and Designation**
Kluane National Park and Reserve	Canadian Department of Heritage - Parks Canada	22,013	II	1943- Game Sanctuary 1976- National Park Reserve 1994- National Park & Reserve
Wrangell-St. Elias National Park & Preserve < ***(National Park)*** < ***(National Preserve)***	USDI National Park Service	53,420 *(32,765)* *(19,655)*	II&V *(II)* *(V)*	1978 - National Monument 1980 - National Park and Preserve
Glacier Bay National Park & Preserve < ***(National Park)*** < ***(National Preserve)***	USDI National Park Service	13,287 *(13,053)* *(234)*	II&V *(II)* *(V)*	1925 - National Monument 1980 - National Park and Preserve
Tatshenshini-Alsek Wilderness Provincial Park	BC Ministry of Environment, Lands and Parks - BC Parks	9,580	II	1993 - Provincial Class "A" Park
Tetlin National Wildlife Refuge	USDI Fish and Wildlife Service	3,739	IV	1980 - National Wildlife Refuge
Kluane Wildlife Sanctuary	Yukon Department of Renewable Resources	6,368	IV	1943 - Game Sanctuary
Chilkat River Eagle Preserve	Alaska Dept. of Fish and Game (ADF&G)	199	II	1982 - State Critical habitat Area
Chugach National Forest	USDA Forest Service	27,959	VI	1907 - National Forest
Tongass National Forest < ***(Russell Fiord Wilderness)*** < ***(Endicott River Wilderness)***	USDA Forest Service	70,606 *(1,411)* *(400)*	VI *(I)* *(I)*	1902 - Forest Reserve 1907 - National Forest

* "Official" areas obtained from respective management agencies

FIGURE 2: PROCESS, METHODS, AND TOOLS



- Generation of systems level maps/charts and summary tables.
- Evaluation of regional character.
- Assessment of implications for ecosystem management of protected areas as well as interagency cooperation.
- Identification of future research needs and evaluation of study process.

- Development of regional GIS via digitizing and data entry using MapInfo.
- Generation of analytical maps
- Dataset combination through data tabulation and matrix creation.
- Assimilation and integration of textual information.

- Interviews with key personel; review and collection of published and unpublished papers, data, reports, maps; regional familiarization
- Review of data and information to identify Phase II components.

DATABASE COMPILATION AND GIS CREATION

The compilation of ecological data and information on the St. Elias region occurred primarily by way of two intensive field sessions during the summers of 1997 and 1998, preceded by a shorter "reconnaissance trip" in December 1996. Library and database searches combined with interviews with key agency personnel and regional stakeholders were the primary methods used. Given the volume of information available, its widespread nature, and the multidisciplinary nature of the study, it was impossible to review all available information. However, a significant effort was made to review and collect as much relevant information as possible, especially as it related to the specific themes of the synthesis.

Information was synthesized in three distinct fashions. The first, and most straightforward, was the synthesis of textual information. The creation of tables or matrices acted as the second tool in synthesizing information. The creation of a regional GIS was the third - and most complex - method of synthesis. MapInfo was used in this task because of its ease of use in digitizing maps as well as the fact that its data is transferable to virtually all other GIS and desktop mapping software packages. The approach utilized in building the GIS was modelled after Aberley's (1993)[2] method for bioregional atlassing where emphasis is placed on region-wide properties and trends as opposed to specific local components. The various institutional, physical, and biological thematic layers were created from the compiled database primarily by way of manual digitization and data entry (Table 2).

EXISTING INTERAGENCY COOPERATION

Interagency cooperation in the St. Elias region was modeled using a relative scale based on formality and complexity. In summary, the results of this modeling indicate a relationship between the formality and complexity of interagency cooperation. Generally, complex interagency cooperation is accompanied by formal agreements while informal agreements are most often used in situations with few actors or less serious management issues. Most interagency cooperation in the St. Elias region is informal in nature and occurs between individual land management agencies. Cooperation is significantly less frequent between Canadian and American agencies.

Based on common characteristics, cooperative efforts in the St. Elias region can be grouped into five general categories. General *communication and information sharing* between agencies sharing a particular resource is the most common type of management cooperation, and is the least formal and least complex of the five categories. *Coordination and collaboration* represents the next level in management cooperation. This is an extensive category that is comprised of a wide variety of cooperative relationships like activity coordination, joint programs, collaborative research and monitoring, and infrastructure and resource sharing. *Cooperative management* is the third level of cooperation. Cooperative arrangements in this category are normally directed by a formal agreement between two or more resource management agencies and may include involvement of end users/user groups or special interest groups. The fourth category, *joint management*, is the most formal and complex. This type of interagency cooperation places a heavy reliance on one or more formal agreements to maintain a very specific arrangement. These agreements are very intricate and detailed

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[2] Aberley, D. (ed.). 1993. *Boundaries of Home: Mapping for Local Empowerment*. New Society Publishers, Gabriola Island, BC.

Table 2: Summary and Status of Regional GIS Map and Data Layers

MULTIPLE SOURCE MAP AND DATA LAYERS (INTEGRATED)			
Theme	**Scale**	**Coverage**	**Details**
Human-Institutional			
Parks and Protected Areas	1:250,000	Entire region	Boundaries and wilderness zones for all designated areas were digitized and clipped to a single map layer with data attached to each polygon.
Land Ownership and Administration	1:250,000	Entire region	Existing digital coverages of land units administered &/or owned by various federal land management agencies; territorial, state and provincial land management agencies; aboriginal-owned lands; Yukon First Nations traditional territories were integrated to create several regional map layers. Pertinent information/data was attached to each polygon.
Major Roads	1:250,000	Entire region	Major roads identified on each relevant 1:250k quadrangle were digitized to a single map layer.
Minor Roads and Trails	1:250,000	Sporadic Coverage	Minor roads and trails identified on some 1:250k quadrangles were digitized to a single map layer but have not been classified.
Settlements	1:250,000	Entire region	Towns and cities from each relevant 1:250k quadrangle were digitized to a single map layer.
Physical Coverages			
Tectonic Terranes	1:2,000,000	Entire region	Fault-bounded tectonic terranes mapped by American and Canadian agencies were digitized to a single map layer with data attached to each polygon.
Earthquake Epicentres	Point data, no scale	Entire region	Location, time, and magnitude data from earthquakes detected by American and Canadian agencies over the past 25 years were integrated into one data layer.
Geothermal Features	Point data, no scale	Entire region	Locations of active and dormant volcanoes, hot springs, and mud volcanoes were plotted onto a single map layer.
Relief	1:1,000,000	Entire region	Hypsography layers from the digital chart of the world were aggregated to one map layer. Elevation data was then attached to each polyline.
Physiographic Regions	1:2,500,000	Entire region	Physiographic regions defined for Alaska, Yukon and BC were digitized to a single map layer. Relevant data was attached to each polygon.

Climate	Point data, no scale	Entire region	Precipitation and temperature data from weather stations in Alaska and Yukon were integrated into one data layer.
Hydrology - Water bodies	1:250,000	Entire region	Rivers, lakes, and marine waters from each relevant 1:250k quadrangle were digitized to respective map layers.
Hydrology - Watersheds	1:250,000	Entire region	Existing digital and digitized analogue sources were integrated to one map layer. Spatial gaps were filled by way of identifying watershed divides through the use of elevation and hydrology layers.
Hydrology - Glaciers	1:250,000	Entire region	Permanent snow and ice identified on each relevant 1:250k quadrangle were digitized to a single map layer.
Biological Coverages			
Dall Sheep Range	<1:250,000	Entire region	Map coverages identifying occupied and historically occupied habitat from Alaska, Kluane NP, Yukon, and BC were digitized into one regional map layer.
Dall Sheep Population Density	Point data, no scale	Sporadic for Region	Population density was extracted or calculated from systematic survey data collected by Wrangell-St. Elias NP&P staff, ADF&G, Kluane NP staff, YDRR staff, and independent researchers, and integrated to create a single regional data layer.
Mountain Goat Range	<1:250,000	Entire region	Map coverages identifying occupied and historically occupied habitat from Alaska, Kluane NP, Yukon, and BC were digitized into one regional map layer. Some existing digital data was integrated into this layer.
Mountain Goat Population Density	Point data, no scale	Sporadic	Population density was extracted or calculated from systematic survey data collected by Wrangell-St. Elias NP&P staff, ADF&G, Kluane NP staff, YDRR staff, and independent researchers, and integrated to create a single regional data layer.
Moose Key Habitat	<1:250,000	Yukon and Alaskan Portions, some BC portions	Map coverages identifying areas of seasonal moose concentration in Alaska, Wrangell-St. Elias NP&P, Kluane NP, Yukon, and BC were digitized into one regional map layer. Existing digital data was integrated into this layer.
Moose Density	Point data, no scale	Sporadic coverage	Population density was extracted or calculated from systematic survey data collected by Wrangell-St. Elias NP&P staff, ADF&G, Kluane NP staff, YDRR staff, and independent researchers, and integrated to create a single regional data layer.
Caribou Herd Distribution and Key Habitat	<1:250,000	Entire region	Map coverages identifying various key habitat and range areas of woodland and barren-ground caribou herds covering portions of Alaska, Wrangell-St. Elias NP&P, and Yukon were digitized into one regional map layer. Existing digital data was integrated into this layer. Pertinent data and information was attached.

Grizzly Bear Key Habitat	<1:500,000	Sporadic across the region	Key habitat, areas of intensive use, known denning sites, and concentrations along fish streams were digitized to a single layer. Pertinent data was attached to each polygon.
Gray Wolf Pack Ranges	1:500,000	Tetlin NWR, Kluane NP and Tat-Alsek	Pack territories identified through surveys conducted by the FWS (1990) and Parks Canada (Skjonsberg, 1996-97) were digitized onto a single layer with pack data attached to each polygon.
Gray Wolf Long Distance Dispersals	Point data, no scale	Kluane National Park and Adjacent areas	Relocation points exceeding 100 km from original capture locations were logged for six collared individuals.

in nature, and often have independent budgets established for their administration. The final category, *international agreements*, refers to cooperative relationships that have been initiated outside of the St. Elias region. They are directed by formal agreements to which the United States and Canada are signees and, therefore, to which management agencies in the St. Elias region must adhere.

Examination of institutional arrangements for managing the St. Elias region indicates that the need for cooperation and the benefits obtained from it are widely acknowledged and recognized. Yet, analysis of the experience with cooperation in the region suggests that a more integrated approach to resource planning and management would assist in reducing the difficulties associated with the fact that numerous agencies share management of the same resource or portions of the same ecosystem. Furthermore, such an integrated approach would provide a suitable framework within which coordination of intergovernmental cooperation could occur. Several existing collaborative initiatives provide a foundation upon which such an approach could be built.

REGIONAL ECOLOGY

As the third objective of this study states, the regional biophysical synthesis was carried out to identify shared ecological features and processes and key linkages between protected areas and adjacent lands. For the most part, the information, data, and maps presented as part of this synthesis represent the first time similar biophysical information from across the entire region has been combined. The regional ecological analysis that followed the synthesis aimed to assess the relative degree to which the region is interconnected - that is, the extent to which the entire area behaves as a coherent unit.

The results of the synthesis and analysis illustrate numerous regional-scale ecosystem components that are shared throughout the entire St. Elias region. Perhaps most significant among these from a conservation ecology viewpoint are populations of large mammals and other species of wildlife which are, in most cases, naturally regulated; intact watersheds with largely natural stream flow dynamics; and vegetation communities and/or plant associations that experience a full suite of natural disturbances with relatively little human intervention. Also identified are linkages between specific areas of the St. Elias region, including the valleys of the Tatshenshini, Alsek, and Copper Rivers which serve as links between coastal and interior areas; low elevation valleys which run out of the central mountainous areas and act as movement corridors for wildlife and carry runoff from the valley glaciers extending from the central icefields; and less tangible and more variable links such as wildlife metapopulations and transboundary vegetation communities and ecosystems.

Despite these shared characteristics, linkages, and ecological influences, the St. Elias cannot really be viewed as constituting a single, coherent region. Results of the biophysical synthesis and ecological analysis indicate that there are equally as many differences between the parks and protected areas, and that these areas are just as closely linked with surrounding unprotected areas. The mountain barrier between coastal and interior areas, as well as the icefields that form the heart of the region are the two primary reasons for these differences. Climatic conditions are so different on either side of the coastal mountain barrier that completely different ecosystems predominate. Further, the icefields of the St. Elias Mountains are so formidable and conditions so harsh that they create a virtual wall to the movement of biota.

MANAGEMENT IMPLICATIONS

The end result of these ecological similarities and differences is that the greater St. Elias region actually represents the point at which several different regional-scale ecosystems converge, rather than one single, coherent region. In light of this, it is difficult to define a single and distinct boundary for collaborative management that includes each of the region's parks and protected areas. Instead the greater ecosystem of each protected area is different from that of the others; even though it may contain a portion of - or all of - another protected area. Rather than a predefined regional boundary, the regional ecology of the St. Elias Mountain Parks seems to advocate a more process-oriented approach to management wherein the development of a coordinated set of principles, goals, and objectives to guide planning and management is more important than defining specific management boundaries.

Given its overall goals of maintaining ecological integrity and sustaining biodiversity and ecosystem processes at a regional scale, ecosystem management is ideally suited for the parks and protected areas of the St. Elias region. Five broad goals and objectives of ecosystem management are often identified:

i. Maintain viable populations of all native species in situ;
ii. Represent, within protected areas, all native ecosystem types across their natural range of variation;
iii. Maintain evolutionary and ecological processes;
iv. Manage over periods of time long enough, and across spatial scales large enough, to maintain the evolutionary potential of species and ecosystems;
v. Accommodate human use and occupancy within these constraints.

After examining these five objectives within the context of the greater St. Elias region's biophysical and institutional environment, several broad management implications can be identified. The most significant of these is the need to maintain the region's largely natural state and high degree of habitat connectivity and incorporate the consideration of broad-scale ecological patterns and processes into planning and management. This is fundamental to maintaining viable populations and ecological and evolutionary patterns and processes such as wildlife migration, species dispersal, and metapopulation dynamics. Moreover, given the widespread impacts associated with piecemeal development evident in more populated regions of North America, it is important that decisions on development within the region do not occur in isolation of one another and that cumulative impacts be considered.

Five foci are recommended to act as frameworks to coordinate and improve the intergovernmental cooperation which is necessary to work towards ecosystem management in the St. Elias region:

< Prince-William Sound - Copper River Ecosystem Partnership
< Glacier Bay Ecosystem Partnership
< Greater Kluane National Park Ecosystem Collaborative
< Tatshenshini-Alsek Watershed International Working Group
< St. Elias Mountain Parks

While the first two of these frameworks already exist, it is recommended that formal commitment by participating agencies be reestablished and that the agencies work toward elevating cooperation beyond the level of communication and information sharing. The second two frameworks do not yet

exist, although variations of them have been conceived in the past. The final framework involves improving cooperative relationships between the four national parks and equivalent reserves. At one extreme, this could mean the four parks forming a formal alliance. At the very least however, this should involve improving communication between the four parks by way of frequent information sharing and regular meetings. One definite objective that should be pursued is the development of a common interpretive program and granting the World Heritage Site a single name which reflects the region's shared natural and/or cultural heritage. This thesis could provide a strong foundation for the development of this interpretive program and could provide useful insight in the process of identifying a name that characterizes the entire region.

Finally, extending management cooperation beyond the level of government to include all stakeholders in planning and decision making is seen as an important objective for each of the five recommended areas.

CONCLUSION

The greater St. Elias region supports a highly diverse suite of species; healthy, naturally regulated populations of many large mammals; and physical processes that still continue with little interference from humans. These features and the processes that govern them still exist in the St. Elias region because of the size and extent of a protected area conglomerate that ranks second in the world in total area. The most important step in preserving these features and processes is to maintain - and even improve - the level of protection offered by these areas. Despite a trend towards broader, transborder, planning and management - much of which is endorsed here - core protected areas with preservation-oriented objectives are still fundamentally required as anchors in regional biodiversity conservation strategies.

However, an emphasis on maintaining and improving protection of the four national parks and equivalent reserves must not come at the expense of ignoring surrounding less protected or unprotected areas. Indeed, just the opposite should occur. Given that Kluane National Park, Tatshenshini-Alsek Wilderness Provincial Park, and Wrangell-St. Elias and Glacier Bay National Parks and preserves share ecological connections that are at least equally strong with surrounding areas as they are with each other, an improved level of cooperation between these management agencies must be fostered. Without an expansion of planning and management across their boundaries the four core areas run the risk of, in time, further isolating themselves from surrounding jurisdictions and even surrounding natural areas.

The ecological and institutional structure of the St. Elias region can provide valuable insight as to how to best approach large-scale biodiversity conservation strategies. Given that the phase of establishing protected areas in the region is likely complete, it can be instructive in assessing best approaches for managing large protected area networks and could serve as a valuable case study in developing integrated management plans for these areas. If other large-scale biodiversity conservation projects - such as Yellowstone to Yukon and Algonquin to Adirondacks - are to be successful, experience in the St. Elias could play an instrumental role.

On a final note, despite the achievements that have been made in protecting the St. Elias region, the road ahead remains challenging. Wilderness has been contested on several fronts in the past several years. In addition to the more historical conflict between wilderness preservation and resource use, the very idea of wilderness has been criticized as “anachronistic, ecologically

uninformed, ethnocentric, historically naive, and politically counterproductive" (Callicott, 1995 quoted in Noss, 1996)[3]. Yet, above all else, this study has shown that it is because of the total size and unfragmented nature of its wilderness that the St. Elias region retains such a high level of ecological integrity and remains as one of Earth's last great natural areas. Management rooted in the science of ecology and its principles - ecosystem-based management - is seen as an important method of assuring that this natural heritage lives on as a legacy to future generations.

[3] Noss, R.F. 1996. Protected Areas: How Much is Enough? In; R.G. Wright (ed.), *National Parks and Protected Areas: Their Role in Environmental Protection*. pp. 91-120. Blackwell Science Inc., Cambridge, MA.